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PHYSICS.—*The constants of spectral radiation of a uniformly heated enclosure.* W. W. COBLENTZ, Bureau of Standards.

In a previous communication to this Journal a general description was given of the work[1] which was completed prior to December, 1912. It was then proposed to observe several more sets of energy curves, at the highest operable temperatures with a vacuum furnace before publishing the exact numerical results. Owing to unavoidable delays in assembling all the apparatus, the intention of witholding all the data until the completion of this investigation has now been abandoned and in the present paper is given a brief summary of the most reliable data now at hand.

The temperature scale used in this investigation, for temperature above 1400°C is the optical scale, which is obtained by adding to the thermoelectric temperatures certain values,[2] which are the mean of several groups of thermocouples. In assembling the present data for publication it was observed that for temperatures above 1400°C there was an abrupt rise in the value of the constant c which increased systematically to abnormally high values for temperatures taken above 1500°. It was therefore necessary to choose between the possibility that (1) this variation in c at high temperature is owing to the failure of Planck's law at high temperatures or (2) that, for the particular thermocouples

[1] Coblentz, Jour. Wash. Acad. Sci., **3**: 10, 1913.
[2] Waidner and Burgess, Bull. Bur. Standards **3**: 205, 1907.

used in this research the aforementioned correct factors for reduction to the optical scale are too large.[3] The writer chose the latter conclusion and the results obtained at high and at low temperatures are now in agreement.

The systematic errors, which formerly caused the mean values of the various sets of observations to differ by 0.2 to 0.5 per cent, are now reduced to less than 0.2 per cent. They were caused by the presence of a disproportionate number of high temperature energy curves, in some sets of data, which contained the aforementioned corrections for reduction to the optical temperature scale. This modification of the correction for reduction of the thermoelectric temperatures to the optical scale has no effect upon the data obtained in 1912 owing to the fact that intentionally, (to save the thermocouple calibration; the difficulty with the scale correction was not forseen) no energy curves were observed at these high temperatures. The former unexplained disagreement between the sets of observations made in 1911 and those of 1912 is now reduced to an excellent agreement. This was to be expected for there was no apparent difference in the methods of operation other than the addition of a number of high-temperature, energy curves to the series of 1911, which required the optical scale corrections.

The series of 1911 is the most accurate as regards low humidity while the series of 1912 excel in having the most improved methods and the longest experience in the work. The results of the two years work are given in Table I. Each value of c is the mean of the number of isothermal energy curves (94 in all) given in column 2, computed by equation (2) published in the previous communication to this Journal. The mean value is

$$c = 14456 \pm 4$$
$$A = 2911 \pm 1$$

In the complete paper it will be shown that the values obtained by Lummer and Pringsheim, if computed by the present methods

[3] In the complete paper it will be shown that, for these particular thermocouples, the mean value correction factors for reducing the thermocouple temperatures to the optical scale are too large by 5 to 7, depending, of course, upon the temperature above 1400°C.

would give a mean value of $c = 14465 \pm 40$ and that the values published by Paschen, if similarly corrected would give a mean value of $c = 14458 \pm 25$.

The most recent communication from Warburg[4] and his associates gives a mean value of $c = 14374 \pm 4$. The mean value of the four sets of investigations weighted as follows (L and $P = 1$ $P = 3$, $W = 10$ and $C = 10$) gives a mean value of;

$$c = 14420 \text{ mikron deg.}$$
$$a = 2905 \text{ mikron deg.}$$

The mean value of the most recent work by Warburg and by the writer is $c = 14415$.

TABLE I

SERIES	NUMBER OF ENERGY CURVES	MEAN VALUE c	REMARKS
1911			
I	26	14,469	Unpainted Marquardt porcelain radiator.
1912			
I	7	14,463	Unpainted radiator as used in 1911. New optical adjustments.
II	14	14,432	Radiator painted with chromium oxide.
III	7	14,466	New unpainted Marquardt radiator.
IV	9	14,446	Radiator painted with the oxides of cobalt and chromium.
V	14	14,476	Radiator repainted; new optical adjustments.
VI	8	14,461	New thermocouples; radiator same as in preceding series.
VII	9	14,436	New watercooled shutter, No. 1, The rest of the apparatus is the same as for the preceding series.

Mean value $c = 14{,}456 \pm 4$ (94 energy curves)
$A = 2911 \pm 1$

The value $c = 14420$ is a convenient one to use. The difference in the values obtained by Warburg and by the writer indicates an uncertainty of about 5° at 1750°C. It is rather remarkable

[4] Warburg—Leithaüser, Hupka, Müller, Sitzber, Akad, Wiss. Berlin I, p. 35. 1913.

that the older data (which were reduced by the present system of computation long before the inconsistencies among the various sets of the present observations were eliminated) are in close agreement with the present results.

PHYTOPATHOLOGY.—*Environmental influences in the pathology of Solanum tuberosum.*[1] W. A. ORTON, Bureau of Plant Industry.

The health and vigor of plants is largely dependent on their adaptation to their environment. Each species has its optimum requirements as to temperature, moisture, light and substratum, variations from which result in failure of the plant to reach a normal or maximum development and predispose it to disease.

Under certain environmental conditions, for example, the plant becomes more susceptible to the attacks of parasites, either because the germination and development of the parasite is favored or because the weakened host has lost its natural resistance. Another type of disease is not associated with any parasites, but comes from some perversion or loss of physiological functions, which seems also, in the last analysis, to be attributable to defects in the environment.

It is to be expected that the most favorable climate for any plant will be that of its nativity, to which it has become adapted in the course of its evolution. Certainly the students of crop plants should consider first the natural adaptations of their plant in the land of its origin, and next any modification that may have resulted from subsequent culture in other countries.

The native habitat of *Solanum tuberosum*, the progenitor of our potato, is believed to be in southern Chile, where it was found growing wild by the early explorers and where it still occurs. Darwin, in the *Voyage of the Beagle* describes his experiences on the Island of Chiloe, where "the wild potato grows . . . . in great abundance, on the sandy, shelly soil near the sea beach."

[1] Address of retiring President, Botanical Society of Washington, February 25, 1913.

De Condolle, after a critical study of the evidence, concludes that the potato is native in southern Chili and expresses doubt as to Peru and the other northern Andean countries, where it was in general cultivation by the natives at the time of the discovery and conquest by the Spaniards and where its present occurrence in a wild or semi-wild condition may be thru escape from the primitive Indian cultures.

That our potato may have come from a region where high altitudes give a temperate climate within the tropics is, however, not impossible, since other species of Solanum do occur thruout the Andean region and northward as far as Colorado, and may have given origin or contributed thru crossing to the potato which we cultivate today. There is great need for further taxonomic studies to throw light on this point. From the physiological standpoint, however, there can be no doubt that the potato originated in a region of low and uniform summer temperature, a fact of the greatest significance to agriculture in the United States, where different climatic conditions prevail.

It will be shown that in the Northern Hemisphere those regions are most successful in the cultivation of the potato where the temperatures during the growing period most nearly approach those of southern Chili, and that the climatic environment is the most important factor influencing the diseases of this crop.

The climate in the district where we believe the potato to be indigenous is marked by very uniformly cool summers and heavy winter rainfall. Valdivia has a mean annual temperature of 52.8°F. the maximum is 90°; and the minimum 30° (figs. 1 and 2); Puerto Montt and Ancud are similar. To the northward, as the climate becomes hotter and drier, the potato is more and more restricted to the higher elevations, where the climate is temperate and the summers cool and equable. The relative atmospheric humidity will be high in these cool regions. This is doubtless a more important point for the normal development of the potato than the absolute rainfall.

Of all countries where it has been introduced the potato perhaps yields best in Scotland, and here we find the summer nearly

as cool as in Chili, though the rainfall is less (figs. 1 and 2). Northern Germany is justly renowned for its potato harvests, which, in bushels per acre, are more than double those of the United States, and there also the growing period is long, cool and equable. The limiting factor is the rainfall, which is low, tho well distributed (Cf. Edinburg and Posen in figs. 1 and 2).

The July isotherm of 65°F. crosses North America not far from the northern border of the United States. Only in Aroostook County, Maine, and parts of northern New York have we develooped extensive potato culture north of this isotherm, which in

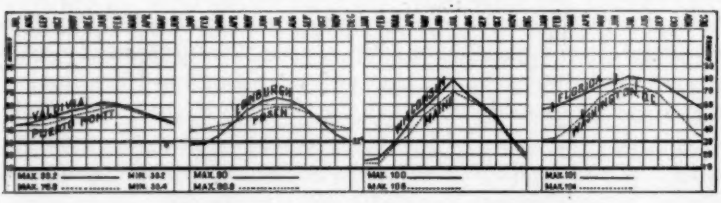

Fig. 1. Curves of mean monthly temperatures for Valdivia and Puerto Montt, in southern Chile, compared with Edinburgh, Scotland; Posen, Germany; Handcock, Wisconsin; Aroostock County, Maine; Federal Point, Florida, and Washington, D. C. Data from the first four were compiled from Hann's "Klimatographie;" the latter four from reports of the U. S. Weather Bureau.

Europe runs south of the principal potato districts of Great Britain and northern Germany. The isotherm of 70°F. (21°C.) for June, July and August nearly marks the southern boundary of successful main crop potato production in the United States. The climate of the greater part of the United States is therefore too hot for best results with this crop. As shown in figures 1 and 3, the production of potatoes in the South is a matter of early spring planting and summer harvesting, or of planting in late summer for autumn harvests. For the latter procedure a type of potato illustrated by the variety McCormick is well adapted in the region of Washington, D. C., a fact worthy of mention here for its significance in the problem of securing a heat resistant potato for southern districts. The summer heat of the United States is the limit-

ing factor in potato production. Only young plants can survive exposure to 90°F. for any extended priod, hence we find a tendency to plant late in the north in order that the time of tuber formation may come during the cooler weather of autumn.

It appears that most or all of our present varieties originated in northern districts, from parent stocks having low temperature requirements. To secure varieties capable of extending potato culture southward local breeding should be practised if stocks possessing the necessary physiological qualities can be found. Our great need is to discover a variety of *Solanum tuberosum*,

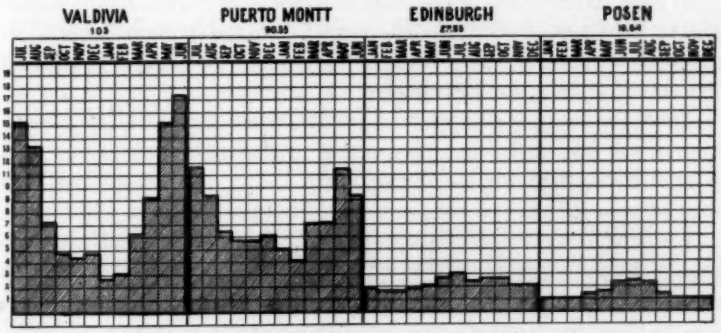

Fig. 2. Chart showing average monthly rainfall for points in southern Chile as compared with Europe.

or a species sufficiently related to hybridize with it, that is indigenous to a region of high temperature, and capable of transmitting to crosses with existing cultivated races a heat enduring quality derived thru better control of transpiration, or in other ways. It will be evident from a consideration of the south Chilean climate that the heat resistant factor cannot be found there. We must turn to more northern and warmer sections of South or Central America, a region that has been very inadequately explored to date, but where Mr. Wight of this Society is now engaged on this mission.

Turning now to the consideration of potato diseases, we shall find in the late blight, caused by the fungus *Phytophthora infestans*, an excellent illustration of the extent to which climatic environ-

ment influences disease. Late blight is limited by its requirements of abundant moisture and moderate temperature, hence it is most common in the Northeastern States, occasionally extending southward in early summer or autumn, never in midsummer. Hot or dry weather checks its spread. These well established facts strongly support the hypothesis that *Phytophthora infestans* is endemic in the native habitat of the potato. Our knowledge of the general principles of immunity in plants further suggests that there would be the place to seek strains of the host plant possessing a high resistance to this parasite.

In early blight, due to the fungus *Alternaria solani*, we find that higher temperatures than those best for the potato appear to promote infection. The range of greatest prevalence is well to the south of that for late blight.

Another instance of apparent geographical limitation of potato diseases is afforded by the wilts due to *Fusarium oxysporum* and *Verticillium albo-atrum* respectively. The Fusarium wilt is southern in its general range, being most prevalent in California, in the warmer irrigated valleys of the West and in the East Central States. Verticillium, on the other hand, occurs in the most northern districts from the Puget Sound to Maine. The two overlap in their distribution but have the general tendency stated.

Pathological conditions not due to parasites are even more conspicuously associated with attempts to grow the potato outside of its natural range. A heat and drought reaction common in the United States is that known as tipburn, where the leaves exposed to the hot sun and low relative humidity of midday curl and burn at the margins, indicating an excessive transpiration. This is seldom met with in Europe.

Premature ripening follows when potatoes bearing half-grown tubers are exposed to the midday heat of our Southern States. There is in addition to the tipburn a yellowing and early death of the foliage. Potatoes produced in these southern conditions lose their constitutional vigor and germinate later, with small weak sprouts and give a smaller yield than seed from northern sources. This constitutional defect is not cured by restoration to a northern environment.

There is another group of apparently physiological or inheritable potato diseases, of which "leaf roll" and "curly dwarf" are most important, which I bring into this discussion because they are probably deterioration phenomena connected in some way not yet fully understood with the effect of unfavorable environmental conditions.

The great losses that have been caused by these diseases both in Europe and America have caused much alarm and led to much investigation and discussion. The suggestion that our potato

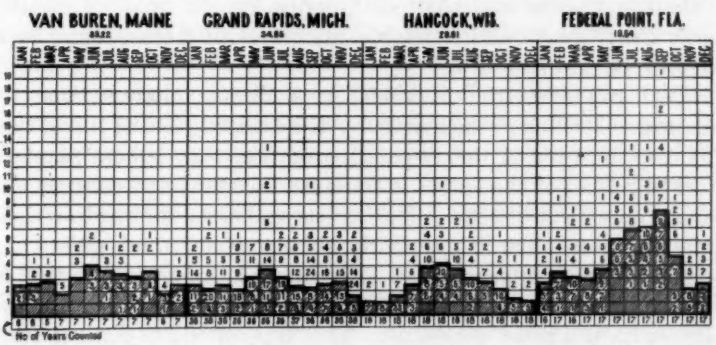

Fig. 3. Average monthly rainfall for four potato centers in the United States. Data from U. S. Weather Bureau. The heavy upper border of the shaded area shows the mean rainfall for the number of years indicated at the base of the column. The figures within the squares in the shaded area show the number of years within the period of record when the rainfall has been below the amount indicated. The corresponding figures in the white squares show the number of years during the period of record when the rainfall has exceeded the amount indicated.

varieties may suffer rapid deterioration thruout extensive districts and without discoverable cause is naturally provocative of uneasiness. While the nature and cause of "leaf roll" and related troubles is still largely a matter of speculation, the haze is partially cleared by the separation of this complex into at least five different troubles, three of which are attributable to known parasites.

As pointed out by the writer in December, 1911, in a paper before the American Phytopathological Society, the following diseases have been more or less confused by various observers:

1. Potato wilt due to *Fusarium oxysporum* (Schlecht.) Sm. & Sw., a disease widespread in the central and southern United States but not yet proved to exist in Europe.

2. Potato wilt due to *Verticillium albo-atrum*, a disease occurring in the northern United States, in Great Britain and northern Europe.

3. Potato rosette and other troubles caused by Rhizoctonia, especially prevalent in the western United States.

4. Leaf roll, an inheritable, probably non-parasitic disease prevalent in Europe and parts of America.

5. Curly dwarf, an inheritable, non-parasitic disease found both in Europe and America.

Leaf roll (Blattrollkrankheit) is a disease characterized by an upward rolling of the leaves, by a decreased yield of tubers and by transmission of the diseased condition thru tubers planted.

The rolling of the leaves is the most constant and conspicuous symptom of this disease. The leaflets curl or roll upward on their midrib, often assuming a nearly tubular shape, and giving the plant a staring appearance. This rolling is sometimes restricted to the upper leaves, while in other cases all or nearly all of the leaves on the plant exhibit it. This type of roll is distinct from the curly leaf condition but a very similar roll may be induced by other causes, such as wet soil, "black leg" and other diseases.

The color of the foliage changes with the advent of leaf roll, but these color symptoms vary greatly, from cases where the leaves assume an unhealthy, light green color to those marked by pronounced yellowish, reddish or purplish colors.

The time of onset is early as compared with Fusarium wilt. The effect on the plant is to check development. There is a lessening or cessation of growth. The duration of life of the plant, in some cases appears to be shortened by leaf roll, but in comparison with the rapid death of American potatoes attacked by Fusarium wilt the leaf roll is very slow in the action.

The endurance of the seed piece as a character of leaf roll is an interesting point frequently mentioned in the German literature, and is considered by Appel to be one of the symptoms of leaf roll. The effect of leaf roll on the tubers is strongly marked.

In general the yield is very much reduced. The diseased hills have numerous tubers very much smaller than normal so that the yield is only about half that of a healthy field. If one uses these potatoes again for seed, the greater part fail to develop, and an uneven stand is the result. The stronger tubers succeed in growing, but the stem remains weak, the leaves are from the beginning considerably rolled and more or less colored. Few or no tubers are found in such hills, so that a complete crop failure results. Stem end browning of tubers is no longer considered a reliable evidence of leaf roll.

The true leaf roll is inheritable. The tubers from diseased plants produce diseased progeny as a general rule. This affords a means of distinguishing from genuine leaf roll those temporary conditions which give rise to a similar appearance of the plants. It is now quite generally admitted that the presence of fungous mycelium is not a character of the leaf roll. The leaf roll diseased plants in America have been free from fungous infection.

The leaf roll disease of potatoes first came into the public eye in Europe in 1905 in Westphalia. In 1907 a more general outbreak occurred in Germany and much alarm was expressed. Its occurrence is certain in Germany, Austria-Hungary, Switzerland, the Netherlands, Denmark, Norway and Sweden, as well as in the United States.

Two developments of leaf roll in this country have been studied. One in a collection of seedlings grown by the Bureau of Plant Industry, the other a destructive outbreak in eastern Colorado and western Nebraska during 1911 and 1912, which was the cause of immense losses, the shipments from one district falling from an expected 7000 cars to 200 cars.

The seedling potatoes showed every degree of variation in plant characters, and in addition many showed distinct evidence of the diseased condition herein described as leaf roll. It is noteworthy that in neither field was there any trace of Fusarium wilt, nor of Verticillium wilt, "black leg" or "mosaic," altho the latter three were common in adjoining fields. The evidence indicates that leaf roll and curly leaf are manifestations of physiological weakness and associated with decline or loss of vigor of the strain.

The hypotheses as to the cause of leaf roll are numerous and varied. It has been argued by one that leaf roll results from the use of unripe tubers for seed; by another, that it is due to the employment of matured tubers; while a third believes that seed from prematurely ripened plants is a cause of leaf roll.

Hiltner is the leading advocate of the theory that the immature seedstock gives an abnormal growth. He limits this to those potatoes which are prematurely ripened by drouth or other untoward circumstances. Hiltner further holds that leaf roll may be the result of an overconcentration of salts as thru excessive applications of fertilizer, of unbalanced composition and applied at the wrong time.

The first appearance of leaf roll in Germany was on the variety Magnum Bonum and was considered as an evidence of varietal deterioration. It seems certain, however, that leaf roll is not a result of "running out" of varieties thru old age, for many strains originated recently are affected. Its occurrence in seedlings has been observed by several workers. An interesting suggestion is put forward by Hedlung that leaf roll is a pathological adaptative mutation, and further, that since acquired characters are not inherited the leaf roll character must be latent in normal potatoes.

The introduction of new and more vigorous varieties affords a hopeful means of ultimately controlling the situation.

Under the name "curly-dwarf" there is to be differentiated from the leaf roll a peculiar disorder known in Germany as "Kräuselkrankheit." This is characterized by a dwarfed development of the potato plant, accompanied by a pronounced curling and wrinkling of the foliage, which has been compared with Scotch Kale and with Savoy cabbage. The stem and its branches, the leaf petioles and even the midribs and veins of the leaves all tend to be shortened in many cases to a very marked extent, particularly in the upper nodes of the plant, so that the foliage is thickly clustered. The diminished growth of the leaf veins, in proportion to the parenchyma, results in a bullate, wrinkled leaf, often strongly curled downward. There seems also to be a tendency to form more secondary branches than normal, and as these

remain short and with curly leaves, the compactness of the plants is more striking.

The color of the foliage in curly-dwarf is typically normal green. The tuber yield is greatly curtailed. Severe cases have no tubers. In others, a few small potatoes are formed. The hereditary nature of the trouble is attested by the German authorities and has been observed by the writer.

In the United States curly-dwarf plays a larger role in the deterioration of our potatoes than in Europe. It must be regarded as a physiological disorder, which crops out in previously healthy stocks, under conditions not yet known to us. Once developed, it is apparently not possible to restore the vigor of the affected hills.

Examination of a variety or seedling collection shows that there are all grades of the condition above described from pronounced types of curly-dwarf to those approaching normal vigor. It will furthermore be apparent that this is a difference inherent in the varieties or strain under observation.

Both leaf roll and curly dwarf develop suddenly from hitherto healthy stocks and both are transmitted by planting tubers from diseased plants. That whole districts should be affected as in Westphalia in 1907 and in Colorado in 1911 indicates a physiological deterioration due to environmental relations, unless a parasite should be demonstrated, which has not yet been done.

The climatic charts presented show that there is a great deficiency of moisture in Germany and Colorado in comparison with Chili. Is it possible that under these conditions varieties of potatoes may lose their vigor and undergo physiological changes comparable with those already noted for southern grown seed?

That the leaf roll disease is being brought under control in Germany by the use of healthy seed potatoes from outside the affected districts supports these hypotheses and lends still more strength to the argument for potato breeding for a higher degree of climatic adaptation.

Altho nothing like the present outbreak of leaf roll has occurred during the last forty years, an examination of old literature shows that about 1770 and in subsequent years there were epi-

demics of "leaf curl" and "Kräuselkrankheit" in England and Germany respectively, the description of which are much like the troubles of today.[2] Are our potato varieties passing thru another period of decline in vigor?

ZOOLOGY.—*Web-spinning fly larvae in Guatemalan caves.* O. F. Cook, Bureau of Plant Industry.

The limestone mountains of the Department of Alta Verapaz, in eastern Guatemala, abound in caves, most of them as yet quite unexplored. Ancient remains show that some of the caves were used for burial places in prehistoric times, which may account for the aversion of the present Indian population to entering this underground world. Two caves on the Trece Aguas coffee estate near Senahú were visited by the writer on March 30, 1906, to see whether they contained millipeds or other cave-dwelling arthropods.

In one of the caves, which was very dry, a few human teeth were found with small circular mounds of earth where ancient pottery vessels had crumbled, tho in some cases the rims remained. The other cave, which was entered by crawling thru a low narrow passage, partly filled with water, had also been used for burial purposes and one of the chambers showed a few rude designs traced in black, something after the manner of Mayan hieroglyphics. There were several large chambers, some of them with lofty roofs and extensive deposits of stalactites and stalagmites. The air was very damp owing to wet walls and dripping water. It was in one of the inner chambers of this cave, probably at least 100 yards from the entrance, that curious fringelike webs were noticed hanging from the roof. A sloping floor brought us up close to the webs, and the light of an acetylene lamp rendered the glistening threads very conspicuous against a background of complete darkness.

The general plan of these webs is entirely unlike that of any spider or other web-building arthropod of the upper world, and could be used only in caves or in very sheltered recesses of forests.

[2] Cf. Thos. Dickson, Memoirs Caledonian Hort. Soc., March 6, 1810.

The only familiar objects to which the webs can be compared are the rope signals that are hung near bridges and railroad tunnels to avoid accidents to train crews. The construction is simple but rather extensive, the webs being usually over a foot long and sometimes nearly 2 feet. Usually the same general direction is kept, along the roof of the cave, but sometimes there is a simple curve and return.

The whole structure is supported from the roof of the cave by a few perpendicular strands, rather irregularly spaced, usually about 2 inches long, and often 2 or 3 inches apart. The ends of these supports are connected by a horizontal cable. Where the roof of the cave is uneven the lengths of the supports are varied, so as to maintain the horizontal direction of the cable. The ends of the cable are drawn up and attached to the roof, and there is only a little sagging between the supports. The remainder of the web consists of a fringe of perpendicular threads attached to the cable above and with the lower ends hanging free. The threads of this fringe are 2 or 3 inches long, and from about 1 mm. to 3 mm. apart. A diagram, kindly prepared by Mr. W. E. Chambers of the Bureau of Plant Industry, is shown in figure 1, to illustrate the plan and appearance of the web. The drawing shows a small section of the fringe with a part of the horizontal cable and one of the vertical supports.

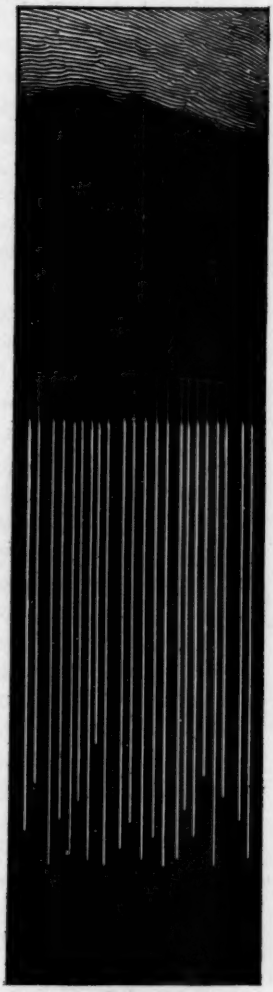

Fig. 1. Diagram of web of cave dwelling fly larva.

The cable and its supports were very slender and had the appearance of or-

dinary spider-webs, but the threads that formed the pendant fringe were much thicker, perhaps 0.5 mm. in diameter, and appeared as though filled or heavily coated with water. The thickening of the threads did not reach the junction with the cable, but began about 5 mm. below, with great regularity.

The construction of such a web implies, of course, the possession of a highly specialized spinning instinct. Indeed, without observing the operation it is not easy to understand how the webs are built unless we suppose that at least the supporting framework of the structure is first laid out on the ceiling of the cave, to be dropped into the pendent position afterward, perhaps when the heavy fringe is added. But even on this assumption the provision for keeping the cable horizontal by varying the lengths of the supports would involve a high order of instinctive skill. The stretching of the cable by carrying a thread along the wall would not seem so difficult, but more talent would be required to carry the supporting threads up to the ceiling from the cable or to let them down from above to meet the cable.

When the pendent threads were gathered upon the finger they formed a mass of slime, which shows that the material is very unlike the silk of spiders. Yet the webs evidently serve the same purpose of trapping insects. Several small insects were found embedded in the slime, from which they could be squeezed out by slight pressure. Mosquitoes and other soft-bodied forms, which have the habit of seeking dark roosting-places, probably furnish most of the victims, but one of the webs had caught a small beetle. If an investigation of the insect life of the caves were to be undertaken, these webs might afford considerable assistance in trapping the small insects that flit along the roofs of the caverns.

The larvae which were evidently the builders of these curious structures, were slender, transparent, vermiform creatures about 20 mm. long. They were found in all cases lying along the main cable of the nest, on which they seemed to slide back and forth, with considerable speed.

The attention of Mr. H. S. Barber, of the Bureau of Entomology who visited Guatemala in the same season, was called to these webs and he saw some of them in another cave near Trece Aguas.

At first he was inclined to believe that the spinning larvae might belong to the family Tipulidae, but he now considers it more probable that they are Mycetophilidae, as several other members of this family are known to spin webs or to live in web-like tubes of slime. The larval characters of this group of flies are so little known that a definite identification of the animals found in the webs is at present out of the question. But as no webs of similar construction seem to have been described, Mr. Barber has urged me to publish my notes on the subject.

The specimen secured from a web by Mr. Barber was somewhat larger and somewhat tinged with brown or black, instead of being entirely transparent like mine. Whether it represented a more advanced stage or a different species could only be conjectured. Mr. Barber also remembered that there were beads of moisture or slime on the fringing threads of the web, whereas my impression was that the threads or rods of slime were cylindrical and of constant diameter up to near the cable, where they were suddenly narrowed. Such differences might depend on the humidity of the atmosphere to which the webs were exposed.

Nothing in the way of a specialized subterranean fauna was found in the caves, unless it be the larvae that spin these webs, and even these may not be confined to the caves. Other webs that may have been made by the same kind of larvae were seen afterward in open recesses in the side of cliffs along the road between Senahú and Sepacuité, tho not in condition to compare with the much more perfect structures seen in the caves.

ABSTRACTS

Authors of scientific papers are requested to see that abstracts, preferably prepared and signed by themselves, are forwarded promptly to the editors. Each of the scientific bureaus in Washington has a representative authorized to forward such material to this journal and abstracts of official publications should be transmitted through the representative of the bureau in which they originate. The abstracts should conform in length and general style to those appearing in this issue.

PHYTOPATHOLOGY.—*Studies of fungous parasites belonging to the genus Glomerella.* C. L. SHEAR and ANNA K. WOOD. U. S. Department of Agriculture, Bureau of Plant Industry, Bulletin 252, pp. 1–110, pls. 1–18, text figs. 4. Issued January 25, 1913.

This bulletin contains an account of investigations of fungous parasites which produce the diseases commonly called "anthracnoses." Most cultivated fruits and many other economic plants are frequently attacked and seriously injured by fungi belonging to the genus Glomerella.

These fungi produce three distinct spore forms in the course of their complete development—conidia, ascospores, and chlamydospores, or appressoria. Until recently the two principal forms of fructification, conidial and ascogenous, have been described and treated as separate organisms, the genetic relationships not being known.

The conidial stage is most frequently found and has usually been referred to one or the other of the form genera Gloeosporium and Colletotrichum. About 500 so-called species probably belonging to the conidial stage of Glomerella have been described.

The genetic connection of the conidial and ascogenous stage of these organisms was first definitely proven in cultures in 1898 by Atkinson in the case of *Glomerella* (Gloeosporium) *cingulata* (Stonem.) S. & v. S. found on privet (Ligustrum vulgare). Since that date the life history of races, strains, or species of the organism from several other host plants has been recorded by various investigators as well as the present writers.

The life histories of forms from 36 different host plants are recorded in this paper. In 17 cases they were developed in pure culture and in the other 19 cases on the host plant, either in moist chamber or under natural conditions. In 31 cases the connection between the conidial and ascogenous stages was first reported by the writers.

In most of the forms studied neither morphological nor physiological conditions sufficient for the segregation of species have been found, but three species are recognized from the 36 hosts. *Glomerella cingulata* (Stonem.) S. & v.S. found on 34 hosts, the type on *Ligustrum vulgare*. *G. gossypii* Edge. on one host, *Gossypium hirsutum* (cotton) and *G. lindemuthianum* Shear on *Phaseolus vulgaris* (wax bean).

Glomerella cingulata is exceedingly variable in all its morphological characters. The cause of this variability is not clear. No constant or definite relation has been established between the environmental conditions and the most important variations observed. The fungus is found to be present in many cases on apparently normal healthy foliage fruits, and sometimes stems, as shown by its development and fructification on these plant parts after their surfaces have been thoroughly sterilized by washing with an antiseptic solution which has been shown to kill not only ascospores and conidia, but also chlamydospores or appressoria of the fungus. Germ tubes appear to penetrate the epidermis and then remain in a quiescent condition until circumstances favorable for further development occur.

Inoculation experiments with fruits show that most of the forms from different hosts will produce the characteristic bitter-rot or anthracnose of fruits of other hosts. Practically the same degree of variability is found in the virility of races or strains of the fungus from the same host as from different hosts.

The production or non-production of the perithecial stage of Glomerella appears to be a fairly well-fixed hereditary race character. The organisms of this genus have developed special features, the most important of which are its method of infection by means of appressoria, and its ability to live in a dormant or inactive condition in the tissues of the host until some specially favorable conditions for its further development occur. In many cases the fungus never develops further until the infected part of the host dies. The fungus also develops in seeds of cotton and bean especially and thus insures its passing the winter and reaching the new crop.

It has been shown by experimenters that diseases of apples and citrus fruits caused by this fungus can be satisfactorily controlled by spraying with Bordeaux mixture, and it is probable that this method can be successfully used in prevention of diseases of other plants caused by the same fungus. The selection and breeding of resistant varieties may also prove practical in some cases. C. L. S.

ANTHROPOLOGY.—*The distribution of animals and its bearing on the peopling of America.* AUSTIN HOBART CLARK. American Anthropologist, **14**: 23–30. 1912.

The land connections between North and South America, and Asia, Africa and Australia, as deduced from a study of zoogeography, are indicated, and the conclusion is stated that the connection between Alaska and northeastern Asia persisted until after man inhabited that region and therefore indicates the path by which the first men reached America. The connection between Africa and the mid-American region was disrupted so far as the zoological evidence shows, in the Cretaceous, the connection between the Australian region and southern South America was broken at a later epoch, but still too early to have formed path for human migration. A. H. C.

MEDICINE.—*An ingenious method of causing death employed by the Obeah men of the West Indies.* AUSTIN H. CLARK. American Anthropologist, **14**: 572–574. 1912.

The West Indian Obeah man of the more advanced type has learned that, on account of the high class of local medical practice, it is no longer safe to employ the common mineral and vegetable poisons which in former days served him so well. He has therefore devised a scheme of infecting flies with streptococci and then liberating them in the houses of his victims. Owing to the habits of the people, especially to their sleeping naked but with the bed clothes (if they possess them) over their heads, to guard against "jumbies" (the local species of ghost), infection is very easily brought about. A. H. C.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

WASHINGTON ACADEMY OF SCIENCES

The 82d meeting of the Washington Academy of Sciences was held at the Cosmos Club, Thursday evening, January 30, 1913. Dr. ARTHUR L. DAY gave an account of *Some observations on the volcano Kilauea in action.* The observations in question were made during the past summer in connection with a successful effort to collect, in the crater of an active volcano, lava gases uncontaminated by the atmosphere.

W. J. HUMPHREYS, *Recording Secretary.*

THE CHEMICAL SOCIETY

The 221st meeting was held at the Cosmos Club on January 9, 1913.

The president appointed committees as follows: *Entertainment*—McKelvy (chairman), Crenshaw, Lathrop, Smither, and Bunzel; *Communications*—Seidell (chairman), Emery (of Bureau of Chemistry), Gore, Turrentine, and Schaller.

The following papers were read: L. A. ROGERS, of the Bureau of Animal Industry: *Drying by the freezing method.* This method, used for drying organic materials of all kinds, consists essentially in drying the frozen material over sulfuric acid in a vacuum dessicator. The ice crystals evaporate directly leaving a very porous and dry powder. Numerous samples were shown and the apparatus was described. The author has used the method for preserving bacterial cultures in a very concentrated and active form.

W. SALANT and CLAYTON SMITH, of the Bureau of Chemistry: *Concerning the pharmacological action of the tartrates.* Read by Dr. Salant. The wide differences in physiological action between optical isomers has been observed for a number of compounds. Contrary to the results of previous observers, the authors find that laevo- and dextro-tartartic acid are about equally active. The manner of introduction of the acid makes a great difference in the effect. A carnivorous animal, such as the cat, is much more resistant to the acid than the rabbit; the difference is not explainable by oxidation alone.

J. A. LECLERC and J. F. BREZEALE, of the Bureau of Chemistry: *The effect of lime upon the alkali tolerance of wheat seedlings.* Wheat seedlings were grown in sand, clay and solution cultures containing the alkali salts sodium chloride, sulfate, and bicarbonate. Salts of calcium, barium, sodium, potassium, etc. were added in small amounts to

these cultures. It was found that the character of the medium did not affect the results. The presence of a few parts per million of calcium enabled the plants to overcome to a large extent the injurious effect of the alkali, altho the plants absorbed as much alkali in the presence of lime as they did in the control cultures. (Author's abstract.)

Discussion: Cameron questioned first whether the beneficial action of clay might not have been due to absorption, second whether sodium chloride found in the ash might not have been present in sap streams. In reply to an inquiry by Sosman, LeClerc stated that petroleum coke was the form of carbon used in the absorption experiments. C. C. Moore inquired as to the bearing of these experiments on the toxic excreta theory. Johnston suggested that the absorption of sodium chloride was a chemical reaction in the case of clay, and a surface effect in the case of carbon. Salant inquired concerning the effect of calcium salts alone, and Cameron stated that calcium chloride was toxic in high concentration.

H. C. GORE, of the Bureau of Chemistry: *The estimation of tartaric and malic acids by the use of uranium acetate and ammonium molybdate.* The effect was shown of increasing amounts of uranyl acetate added to solutions of free and neutralized malic and tartaric acids respectively. Excessive amount of uranyl salt were found to cause depressions in the very high optical rotations observed. In case of malic acid the depressions were slight and the maximum activity could be restored by adding optimum amounts of acetic acid; in case of tartaric acid the depressions due to excess of uranyl salt were much larger and the readings were only slightly increased by addition of acetic acid. Ammonium molybdate caused very large increases in specific rotatory power of the two acids. In the case of malic acid the maximum polarizations were much less for the neutralized than for the free acid; small additions of acetic acid stimulated the polarizations very greatly, and in presence of suitable amounts of acetic acid and ammonium molybdate the relation between the malic acid present and the polarizations was found to be linear. With tartaric acid the rotations shown when the free acid was treated with ammonium molybdate were higher than when the neutralized acid was used. The stimulating effect of acetic acid, while large, was smaller than with malic acid. Conditions were not found under which the relation between the polarizations and amounts of tartaric acid present were linear, but the specific rotatory power increased with increasing concentration. (Author's abstract.)

Discussion: Hillebrand suggested the use of the method inversely for the rough estimation of uranium and molybdenum in ores.

ROBERT B. SOSMAN, *Secretary.*

THE GEOLOGICAL SOCIETY OF WASHINGTON

The 264th meeting was held in the Cosmos Club, January 22, 1913, at which the following communications were presented:

A fall of volcanic ash at Juneau, Alaska in July, 1912: R. H. CHAPMAN. Parts of a letter from Benj. D. Stewart, dated July 28, 1912, were read, giving a description of a fall of volcanic ash due to the eruption of Mount Katmai.

A septarian from New Mexico: W. T. LEE.

The habitat of the Cambrian brachiopoda: LANCASTER D. BURLING. A study of the Cambrian and Lower Ordovician, nearly 1200 localities, represented in the United States National Museum shows: (1) that from about 72 per cent of the localities brachiopods have been identified; (2) that, dividing the sediments into three groups, shale, sandstone, and limestone, 60 per cent of the genera and 85 per cent of the species have been identified from but one type of sediment; and (3) that, after dividing the localities into three groups, figures are obtained for each of the groups, indicating that the number of species per locality is smaller in shale than in sandstone and greatest in limestone. The accordance of the results seems to justify the conclusion that habitat influenced not only the nature but the number of species which are to be found in any particular locality.

The relations of ilmenite to magnetite in titaniferous magnetite. (Illustrated): JOSEPH T. SINGEWALD, JR. Experiments that have been conducted in the magnetic separation of merchantable iron ore from titaniferous magnetite have yielded varying result, but in all cases only a partial elimination of titanium, and a study of the ores to show their mode of combination was undertaken. The problem was easily solved by the study of etched polished sections of the ores in reflected light. Ilmenite is unaffected by hydrochloric acid; whereas, magnetite is readily acted on, and etches to a dull black surface. On examining the etched specimens it is at once apparent that they consist of granular aggregates of ilmenite and magnetite. The magnetite grains are not homogeneous but contain minute intergrowths of ilmenite. These intergrowths are in part irregularly disseminated through the magnetite and in part regularly intergrown with definite crystallographic orientation.

Construction of a structure map of the northern anthracite field: N. H. DARTON. The map showing the structure of the northern anthracite coal basin has been under construction for several years and is now nearly ready for publication. It was prepared incidentally in connection with a study of the origin of methane in coal, for the Bureau of Mines. The northern anthracite basin was one of the areas selected and as one branch of the inquiry was to ascertain the relation and the occurrence of methane to the deformation of the beds the structure had to be plotted in detail in various parts of the area. The data given on the large scale mine maps, were utilized as far as practicable but in areas not reached by mining the structure was determined from surface dips aided by numerous bore hole records. The horizon selected for contouring was the lowest notable coal bed (Dunmore—Red Ash) and its configuration is

represented by 100-foot contour lines with sea level datum. The contours based on mine surveys in these lower beds are shown as full lines; those constructed from workings in overlying beds are shown by broken lines, while in areas not yet worked, dotted lines are used. The structure is still further represented by 15 vertical sections which cross the basin at frequent intervals.

Much attention was given to the extension of the different coal beds and it is now practicable to correlate all the beds thruout the basin. The investigation has incidentally disclosed structural details, showing notable discordance in the forms of the flexed beds at different depths and in harder and softer layers. It was necessary to make a very careful study of the conditions under which variations of this character occur in order to represent the probable position of important coal beds in areas not yet worked. As such a representation becomes a prediction and may affect plans for the future exploitation of coal, its occurance is a matter of great economic importance especially in the deeper basins where some of the coal lies nearly half a mile below the surface.

FRANK L. HESS, *Secretary.*

ANTHROPOLOGICAL SOCIETY

A special meeting of the Anthropological Society of Washington was held March 6, 1913 in the National Museum, the President Mr. George R. Stetson in the chair. Dr. WALTER HOUGH read a paper on: *Savage mutilations for decoration.* The paper was a short excursion into the enormous field of custom with regard to ethnic mutilations, and sufficient examples were given to lay the subject rather completely before the society. In it were described the most striking forms of head shaping by pressure in infancy; the various forms of teeth mutilations; ear, nose, cheek and lip modifications and ornaments; pressure and mutilations in the arms, waist and limbs, and modifications of the bones of the feet. With mutilations also should be considered, perhaps, extraordinary hair dressing and treatment of the finger nails.

Many slides were shown of tatooing, scarification and decoration of the skin by means of dyes and pigments, and some of their multifarious meanings given. On the whole, it was concluded that ethnic mutilations originated from many concepts, the more important being a desire for identification, in some cases individual, but in most cases tribal; a desire for ornamentation, mainly individual in its treatment, but following environmental and tribal fashions; and also very important mutilations growing out of superstitions and religious ideas.

Many ethnic mutilations also relate to sex, puberty, social rank, honor for warlike feats, and the like. All these ideas, which at times have been advanced as the explanation of the causes, show that the matter is extremely complex. The bearing of ethnic mutilations on primitive surgery was also hinted at, as well as its effects on the development of costume.

Dr. Williams and Dr. Swanton made certain inquiries and brief remarks. The meeting then adjourned.

WM. H. BABCOCK, *Secretary.*

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